

Using an online machinery management network to improve plant efficiency



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Korea Electric Power Corporation (KEPCO), Korea's government-owned electric power company, owns thirteen subsidiaries and joint-venture companies, and operates forty-four nuclear, hydro and thermal electric power plants across the country. Approximately 38,000 employees work for KEPCO. As of December 1997, installed generating capacity was approximately 40,492 MW. Of that amount, nuclear energy accounted for 25.5%, coal 24%, oil 21.6%, hydro 7.7% and LNG 21.2%.

As the twenty-first century approaches, KEPCO is dedicated to becoming a world-class electric power company under the motto, "Creating a new KEPCO image." To promote growth, KEPCO is focusing on improving the timeliness of its decision-making process, developing a systematic innovative procedure, ensuring proper personnel management, and increasing productivity by maintaining a high level of efficiency in machinery management and facility operation.



However, to remain competitive today and in the future, KEPCO must also learn to network the skills, experience and knowledge-base developed at each plant to improve the efficiency and effectiveness of the entire system.

Machinery management is of critical importance to growth, as any operation downtime seriously impacts the company's bottom line. Like many process industries (petrochemical, oil refinery, gas and steel), KEPCO has implemented effective maintenance programs at each plant to reduce downtime and production losses and to enhance plant safety. Many skilled people have worked hard, and a significant amount of capital has been invested, to make plants operate at peak performance. One concept that KEPCO investigated to enhance plant productivity and safety through networking is Bently Nevada's "Move Data, Not People™."

To implement this concept, KEPCO recently completed a new nationwide machinery data man-



agement network that allows their machinery vibration specialists to share online and archived machinery information on a nationwide scale (Figure 1). The computerized online vibration monitoring and diagnostics systems at various KEPCO plants are connected to an existing Local Area Network (LAN). The LANs are then connected nationwide as a fiber optic Wide

Area Network. Using this system, a machinery expert at any remote plant location can quickly review current online machinery

information as conveniently as if he were already in the plant. He does not need to travel to the site.

By the end of 1997, thirty-six different plant units had been interconnected through KEPCO's nationwide network. The goal is to connect all existing KEPCO plant sites into this network by the end of 1998 and to connect all new units under construction as they come online. The system has been named KOMMNet - KEPCO Online Machinery Management Network. KEPCO may be the first company in

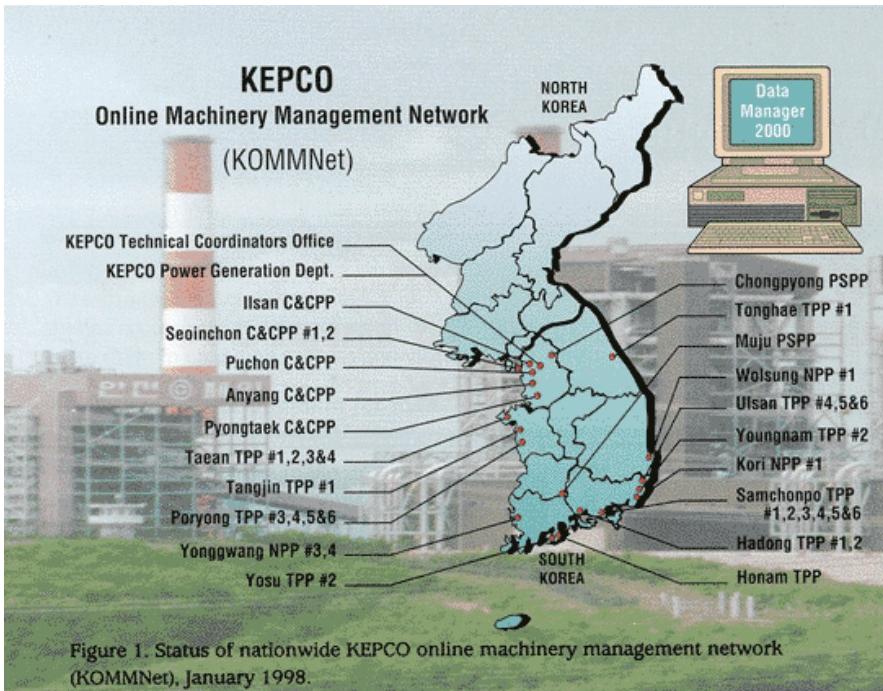


Figure 1. Status of nationwide KEPCO online machinery management network (KOMMNet), January 1998.

the world to have installed such a large, nationwide, online machinery management network.

Plant-wide online machinery management

KEPCO has long advocated online plant-wide machinery protection and management systems, the kind required for an effective predictive maintenance program. Since the late 1980's, KEPCO, after careful reliability evaluation, installed Bently Nevada transducers, monitors and diagnostic systems on all their new units and on many existing ones. As a result, many KEPCO power plants are now equipped with Bently Nevada computerized online continuous monitoring and diagnostics systems to protect and manage critical and essential machines, such as main Turbine Generator sets, Boiler Feedwater Pumps (BFP) and Balance of Plant (BOP) equipment.

Team approach

KEPCO's machinery management program has been a team approach, involving operators and maintenance personnel. Each plant control room has a display terminal to inform

operators of an impending machinery vibration problem. This online computerized machinery protection and management system enables KEPCO to better manage machinery through early detection of impending problems. In case of a vibration alarm, an operator initially evaluates data and then typically calls a maintenance person. At KEPCO, decisions are usually made at the plant level whether or not to continue running, to change the operating conditions, to switch to a spare or to shut down the machine. Normally, various forms of machinery dynamic vibration information, the condition of process variables, and operation and maintenance histories are examined to determine the cause and severity of the problem.

Business problems

Lack of on-site machinery management experts

Unfortunately, machinery management experts are not usually available at each plant site to interpret machinery data and make appropriate recommendations to decision makers in a timely manner. Machinery management experts are typically required to review and interpret large amounts of

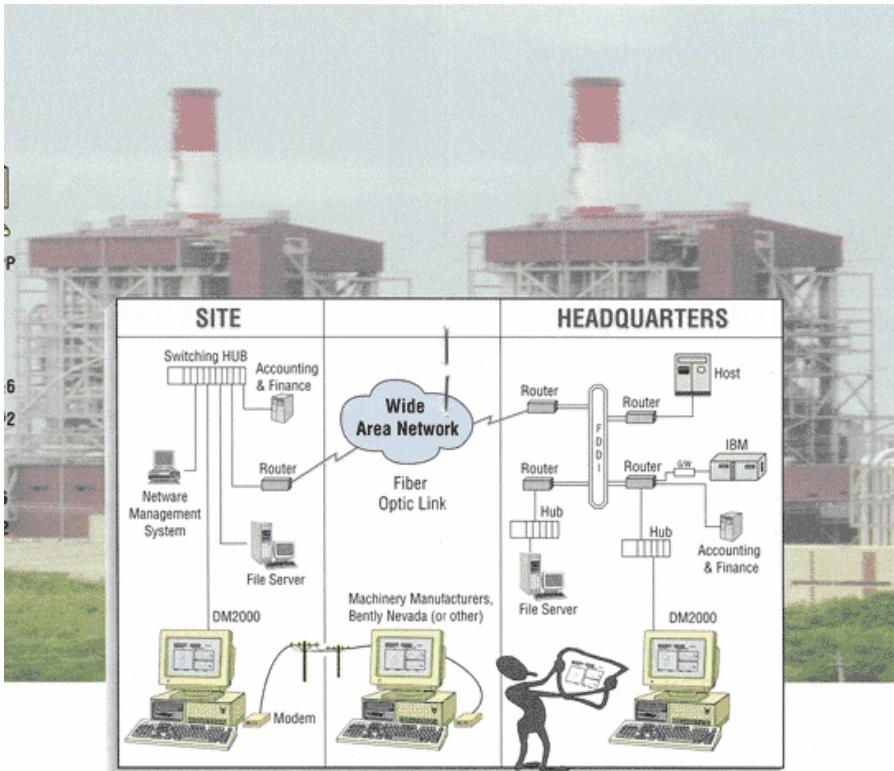


Figure 2. KOMMNet architecture designed by KEPCO and Bently Nevada System Integration Engineering.

machinery information to identify and diagnose the root causes of various machinery problems. However, at KEPCO, there is a shortage of such people, especially at plant locations. Even if an expert is available, in most cases, the person would have to spend many valuable hours, if not days, to travel to the site, either from headquarters or another remote location. For this reason, the great potential of the computerized online machinery management systems at KEPCO has not been fully realized.

No sharing of online machinery information

The existing online machinery management system at each KEPCO plant has been typically used as a stand-alone system for plant operators and maintenance personnel. Because it was not connected into a network or a modem, online machinery information could not be shared simultaneously with the group of machinery management experts normally located

at headquarters or at other remote locations.

Lack of technical training programs & corporate learning

Since vibration is one of the most important parameters for effective machinery management, it is important for plant maintenance personnel as well as operators to have a basic understanding of machinery vibration. It usually takes years of training and field experience to become a competent machinery management expert. However, relatively simple systematic training programs on vibration monitoring and diagnostics would greatly help most maintenance personnel and plant operators. These programs could teach basic machinery management skills. As a result, proactive steps could be taken to minimize further damage from any impending machine problems until a more permanent root cause analysis and remedy could be determined and implemented.

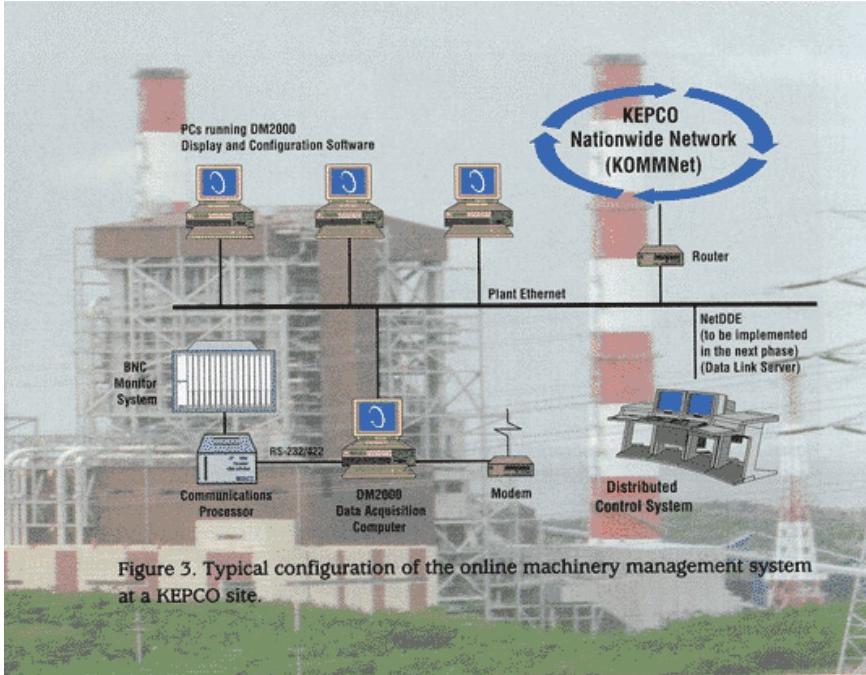


Figure 3. Typical configuration of the online machinery management system at a KEPCO site.

KEPCO has long recognized the value in short-term and long-term, external and internal training programs. However, frequent job transfers by trained field personnel make the investment less effective. Once a trained person leaves his or her position, a vacuum is usually created until the position is filled again by a qualified person.

For this reason, KEPCO has advocated plant information systems that support corporate learning. KEPCO's vision is to establish a machinery information system that delivers actionable information to the right people at the right time in a form that is easy to interpret. This system must easily interface with other systems and allow people to share information freely without delay, so corporate learning can quickly take place.

KEPCO's Online Machinery Management Network

Fortunately, since the late 1980's KEPCO has made Bently Nevada Corporation (BNC) products their standard for online machinery management systems. This includes all of their new plants and most major existing Korean plants. This standard-

ization made it relatively simple to integrate all their BNC systems together to share data over a network. All of these systems were upgraded to BNC's newest online machinery data management system, Data Manager® 2000 for Windows NT™ (DM2000). Since the DM2000 data acquisition server uses the Windows NT operating system, it can communicate over most existing and future computer networks. Windows NT also allows one DM2000 station to communicate with a remote DM2000 station by modem.

In addition, DM2000 Display Software runs under Windows 95. Therefore, you can view comprehensive machinery information on almost any computer, anywhere in the world, not just on dedicated, on-site workstations. This allows machinery management experts to solve various machinery problems online regardless of where they are located. The DM2000 System also allows process data to be integrated from various Distributed Control Systems (DCS) via network or dedicated serial interface. Process data enhances root cause analysis by an experienced machinery management



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expert or by a knowledge-based Decision Support System (sometimes called an "expert system").

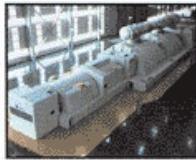
After this ambitious nationwide network plan was reviewed and approved, project implementation began in August 1996, and the first phase was completed in December 1996. The existing KEPCO fiber optic network enabled the integration of all DM2000 Systems nationwide. System installation was done at a minimal cost.

Three phase introduction

The first phase was completed by the end of 1996. Twenty-one power station DM2000 units (Data Acquisition stations) were interconnected via KOMMNet. Two display-only stations, located in the Power Generating Department office and the Technical Coordinator's Office at KEPCO Headquarters in Seoul, were also added.

In the second phase, completed by the end of January 1998, KEPCO installed and integrated fifteen additional DM2000 stations into the KOMMNet system (Figure 1).

The third phase is still in the planning stage and will be implemented during 1998.



During this stage, another twenty-two DM2000 stations will be added to the KOMMNet system. Each DM2000 Data Acquisition station will be interfaced with a plant DCS to provide various process variable data to the online machinery management system.

Figure 2 shows the architecture of the KEPCO nationwide network system linking a plant site, headquarters and third party expertise. Figure 3 shows the BNC online machinery data management system installed at a typical KEPCO plant.

Conclusion

The Nationwide KOMMNet system, operational since the end of 1997, is already an important tool for many KEPCO engineers. Through the network, KEPCO machinery management experts have plant online machinery management information at their fingertips whenever and wherever they wish. Third party consultants can also receive data from the KOMMNet system via a phone line, with the proper security clearance.

Before KOMMNet was implemented, KEPCO machinery management experts normally spent half their time traveling to sites, setting up equipment and acquiring data. Using the KOMMNet system, they now spend most of their time on more productive activities, such as analyzing data and making decisions. They can do this in a more comfortable setting and still have

access to a complete set of available data. Since the KOMMNet system became operational in 1997, a total of twenty-one machinery problems at different plant sites have been solved using DM2000 data according to Mr. Jae-hong JEONG, one of the machinery management experts working in the KEPCO Technical Coordinator's group. No trips to plant sites were required.

The KOMMNet system uses currently available computer and telecommunication technology, combined with a state-of-the art machinery data management system developed by BNC, the world's leading expert in machinery management. The end result is to Move Data, Not People, which will certainly result in a great improvement in productivity and plant safety through better and more timely management of KEPCO's assets, machinery and people.



Mr. Jae-hong JEONG reviewing machine data plots from Data Manager® 2000 software.

KEPCO fully recognizes that the KOMMNet system is a tool to effectively address and solve many critical business problems. For this reason, corporate learning and personnel training to develop skilled machinery engineers are still high priorities. ☐